

Sensors for Ablative Thermal Protection Systems

Readiness level:
☐ TRL 1-3: Concept
☐ TRL 4-6: Prototype
☒ TRL 7-9: Demonstrated

NASA Ames Instrumentation Workshop

September 16, 2015

Technology / Application

Problem:

Uncertainty in computational models of ablative thermal protection system (TPS) performance leads to high design margins.

- Results in higher TPS mass and reduced payload mass

Application:

NASA missions that will encounter the atmosphere of any celestial body

- Earth, Mars, Venus, Saturn, Jupiter, Titan...

Purpose:

Measure aerothermal environment and performance of ablative thermal protection systems during atmospheric entry.

Technology:

Adapt sensing technologies to ablative thermal protection system materials

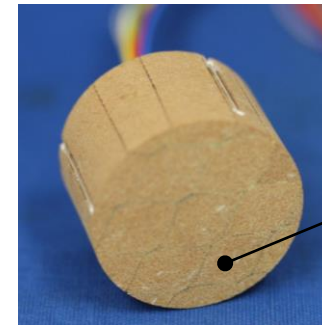
- Instrumented plugs include embedded thermocouples and isotherm following sensors (e.g. HEAT sensor*)
- Radiometers measure shock layer radiation

**Oishi, T., Martinez, E., Santos, J., "Development and Application of a TPS Ablation Sensor for Flight," AIAA 2008-1219.*

Challenges:

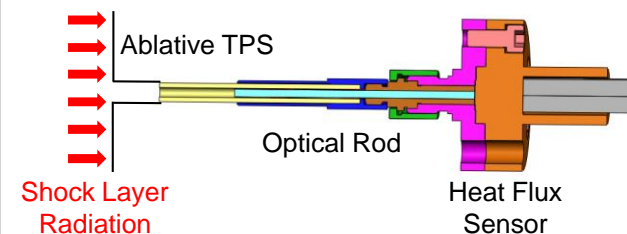
- Must show "do no harm" to the primary mission
 - Requires extensive arc jet testing and other environmental testing
- Mission Infusion: Instrumentation sometimes only benefits the next mission
- Logistical and technical issues of integration

Orion EFT-1 Instrumented Plug



Embedded thermocouples and HEAT sensor

Orion EFT-1 Radiometer



Funding / Timeline

Instrumented Plugs: Flew on MSL (MEDLI, SMD, 2012), Orion EFT-1 (Earth, HEOMD, 2014) and will fly again on Orion EM-1 (2018) and Mars 2020

Radiometer: Flew on Orion EFT-1 (Earth, HEMOD, 2014) and will fly again on Orion EM-1 (2018)

All Discovery missions with atmospheric entry components are now required to include entry instrumentation (same requirement anticipated for New Frontiers AO)

POC

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